REMARKS

Reconsideration and allowance of the above-identified application are respectfully requested. Upon entry of this Amendment, claims 47-92 will be pending. Claims 47, 50, 55, 61, 70, 73, 78 and 84 are amended herein as described below.

In the Office Action, claims 47-92 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for reciting "in the time domain" in the independent claims 47, 50, 55, 61, 70, 73, 78 and 84 which purportedly lacks antecedent basis. The technical expressions of " in the time domain" and "in the frequency domain" are well known in the art of signaling systems and should not raise an issue regarding antecedent basis. Nevertheless, the Applicants respectfully submit that the amendment of the claims 47, 50, 55, 61, 70, 73, 78 and 84 to recite "in time domain" overcomes this basis for rejecting the claims.

In the Office Action, claims 47-54 and 70-77 are rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,694,389, to Seki et al (hereinafter Seki et al '389 patent), in view of U.S. Patent No. 5,771,224, to Seki et al (hereinafter Seki et al '224 patent), and in further view of U.S. Patent No. 6,359,933 to Aslanis et al (hereinafter Aslanis et al patent). Claims 55-60 and 78-83 are rejected under 35 U.S.C. §103(a) as being anticipated by the Seki et al '389 patent in further view of the Aslanis et al patent. Finally, claims 61-69 and 84-92 are rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,646,935, to Ishikawa et al (hereinafter the Ishikawa et al patent), in view of the Seki et al '389 patent, and further in view of the Aslanis et al patent. The Applicants respectfully traverse each of these claim rejections.

With regard to the rejection of claims 47-54 and 70-77 under 35 U.S.C. §103(a), the independent claims 47, 50, 70 and 73 each recite insertion of a reference symbol into a signal that is defined using an amplitude modulated bit sequence. In addition, the independent claims 47, 50, 70 and 73, as amended herein, each recite a reference signal that is inserted into the signal in time domain, wherein the reference

symbol comprises a real part and an imaginary part that are equal and formed by the amplitude modulated bit sequence.

Applicants respectfully submit that none of the applied patents singly, nor in combination, disclose or suggest the use of an amplitude modulated bit sequence to generate a reference symbol. First, the Seki et al '389 patent does not teach frame synchronization as purported in the Office Action, but rather relates to a system for detecting and compensating for a carrier frequency offset based on a frequency reference symbol. Accordingly, the Seki et al '389 patent teaches away from the claimed invention such that there is no motivation to use or modify the teachings of this reference to support an obviousness rejection, as explained in further detail below. Secondly, the Seki et al '389 patent does not disclose or suggest the use of an amplitude modulated bit sequence to generate the frequency reference symbol.

According to the Seki et al '389 patent, a frequency reference symbol is used in order to detect the carrier frequency offset based on an offset of the position of decoded data of the frequency reference symbol (see column 4, lines 32 to 36). The structure of the reference symbol according to the Seki et al '389 patent is described making reference to Fig. 3 thereof, i.e., on column 4, line 58 to column 5, line 41. According to the Seki et al '389 patent, one OFDM symbol consists of N carrier positions wherein the middle m carrier positions are frequency reference carrier positions for frequency references. With respect to the m frequency reference carrier positions carriers, carriers are arranged in a pattern of an M sequence (pseudonoise code), wherein no carriers are present when the code is "0" and carriers are present when the code is "1".

Thus, according to the Seki et al '389 patent, carriers are present or not depending on the pseudonoise code. Thus, the carriers are modulated making use of the pseudonoise code, which does not teach or suggest amplitude modulation of a bit sequence and insertion of the amplitude modulated bit sequence into a signal, as recited in the independent claims 47, 50, 70 and 73 of the present application. Further, the element 322 in Fig. 5 and the text at column 4, lines 20-25 of the Seki et

al '389 patent relied in the Office Action to purportedly teach frame synchronization is merely generation of clocks and timing pulses in the individual circuits of the OFDM receiving apparatus illustrated in Fig. 5, as stated in column 7, lines 45-47 of the Seki et al '389 patent, and therefore not frame synchronization.

Reference symbols are inserted into the frame structure of an MCM signal to facilitate location of guard intervals and therefore the information in the signal. In the prior art, finding and synchronizing to the reference symbol is the first and most important task undertaken at the receiver prior to MCM demodulation, as explained in the text extending from page 2, line 18 to page 3, line 6 of present application. As stated on page 6, lines 8-11 of the present application, most prior art methods for frame synchronization require prior achieved frequency synchronization or become prohibitively complex when the received signal is corrupted by a large frequency offset or fading. The frame structure of the present invention, which comprises an amplitude modulated bit sequence inserted into a signal as a reference symbol, provides for frame synchronization even in the case of carrier frequency offset. The Seki et al '389 patent, on the other hand, teaches removal of a carrier frequency offset. As stated in the abstract of the Seki et al '389 patent, the frequency reference symbols are used to detect carrier frequency offset. Thus, there is no motivation to use, modify or combine this reference with other references to support an obviousness rejection of the claims that recite a reference symbol comprising an amplitude modulated bit sequence, among other aspects of the present invention.

Column 2, lines 10-40 of the Seki et al '224 patent is relied on in the Office Action for its purported disclosure of inserting an amplitude modulated bit sequence into the signal as a reference symbol. This is incorrect. Column 2, lines 11-17 of the Seki et al '224 patent state that reference symbols are inserted into predetermined restricted slots in a transmission frame, and PSK information symbols and information symbols are inserted into other slots in a selected positional relation with respect to each other. The reference symbols, however, are transmitted such that the phase and amplitude of each carrier are known (see column 7, lines 37-42). As stated in column

8, lines 32-43, reference symbol data is generated having amplitude and phases which are already known such as a sine-sweep signal and therefore does not disclose or suggest the reference symbol of the present invention.

The independent claims 47, 50, 70 and 73 of the present application each recite frame structure wherein each frame has a reference symbol inserted therein in time domain and as an amplitude modulated bit sequence. As discussed above, the Seki et al '389 patent does not teach or suggest these aspects of the claimed invention, among other aspects. Moreover, according to the Seki et al '389 patent, the reference symbol generator 206 is provided upstream of the IFFT circuit 208, so that the reference symbol is inserted in the frequency domain. The independent claims 47, 50, 70 and 73, however, recite that the amplitude-modulated bit sequence is inserted into said signal in time domain.

In addition, the Seki et al '224 also teaches away from the proposed combination since it discloses the conventional method of using reference data for which amplitude and phase are known. By contrast, the present invention teaches a frame synchronization method that is preferably performed prior to other and without knowledge of other synchronization efforts. As discussed in further detail below, the reference symbol of the present invention can be detected even if the frequency synchronization loop is not yet locked or even in the case of a carrier frequency offset. The Seki et al '224 patent, on the other hand, teaches that the PSK information symbol must first be demodulated and processed to determine variations in the amplitude and phase of the received signal prior to correcting the reference symbols for subsequent use in demodulating the information symbols (see column 7, lines 11-17 of the Seki et al '224 patent).

As described on page 13, lines 4-32 of the present application as filed, the present invention permits for finding frame headers independently of other synchronization information and, thus, for positioning the fast Fourier transform windows correctly. Thus, according to the present invention, the frame synchronization will be performed as the first synchronization task. Synchronization

to the reference symbol, that is, the frame header, is the first step to initiate radio reception. The reference symbol of the present invention is structured to accomplish this. Information contained in the reference symbol must therefore be independent of other synchronization parameters, e.g., the frequency. For this reason, in accordance with the present invention, the form of the reference symbol selected is an amplitude-modulated sequence in the complex base band. The information sequence is preferably selected in a way that makes it easy and secure to find it in the time domain.

In addition, as described on page 16, lines 1-20 of the present application as filed, the present invention shows how to find a reference symbol by a detection method which is simple. The synchronization methods according to the present invention are independent of other synchronization steps. If the information needed for the synchronization is contained in the envelope of the preamble, that is, the reference symbol, the reference symbol is independent of possible frequency offsets. Thus, a derivation of the correct downsampling timing and the correct positioning of the FFT window can be achieved. The present invention relates to signals having a frame structure and a frame synchronization of such signals. The signal comprises a reference symbol and, according to the present invention, the reference symbol is formed by performing an amplitude modulation of a bit sequence and inserting the amplitude-modulated bit sequence into the signal. As can be seen from Fig. 2 of the present application, for example, the amplitude-modulated bit sequence is inserted at 116 and therefore after conducting the inverse fast Fourier transform 110 such that the reference symbol is inserted in the time domain. At the receiver's end, the received signal is down-converted, an amplitude demodulation of the down-converted signal is performed in order to generate an envelope, and the envelope is correlated with a predetermined reference pattern in order to detect the signal reference pattern of the reference symbol in the signal. Then, frame synchronization is performed based on the detection of the signal reference pattern. As can be seen from Fig. 2 of the present application, the frame synchronization unit 134 is arranged upstream of the fast

Fourier transform unit 140. Thus, according to the invention, the frame synchronization is conducted in the time domain and does not employ conventional reference data whose amplitude and phase are already known or require other synchronization efforts prior to frame synchronization. The Seki et al '224 patent therefore teaches away from the present invention and there can be no motivation to combine this reference with other references in the office action to support a rejection of the claims.

The Office Action states that the Seki et al '389 patent and the Seki et al '224 patent do not teach inserting in time domain the amplitude modulated bit sequence, and relies on the Aslanis et al patent to overcome this deficiency. The Aslanis et al patent relates to a method for frame synchronization by correlating frequency domain complex amplitudes of a synchronizing frame with a stored synchronizing pattern. The portion of the background section of the Aslanis et al patent relied on in the Office Action discusses inserting a relatively random frame synchronization sequence into a time-domain signal sample stream at a transmitter for extraction and correlation at a receiver. Thus, the reference symbols according to the Seki et al '389 patent and the synchronizing sequence or pattern according to the Aslanis et al patent are provided for serving different purposes (i.e., carrier frequency offset compensation and frame synchronization) and, therefore, a man of ordinary skill would not combine the teachings of these patents. Further, none of the cited patents, that is, the Seki et al '389 patent, the Seki et al '224 patent, nor the Aslanis et al patent discloses or suggests the use of an amplitude modulated bit sequence.

In addition, the independent claims 47, 50, 70 and 73 of the present application each recite that the reference symbol comprises a real part and an imaginary part, wherein the real and the imaginary parts are equal and are formed by the amplitude modulated bit sequence. To provide support for this amendment, reference is made to the original specification on page 27, lines 21 to 24 where it is outlined that the reference symbol amp_int is inserted into the signal and that the reference symbol is formed by i_q_int + j*i_q_int. i_q_int represents the amplitude modulated bit

sequence or, in the illustrative embodiment, an interpolated version thereof. Thus, it is clear from the equation on page 27, line 21 that the reference symbol has a real part and an imaginary part, which are equal and which are identical to the amplitude modulated bit sequence.

The applied art cited in the Office Action is silent about a reference symbol comprising a real part and an identical imaginary part and formed by an amplitude modulated bit sequence. Contrary thereto, the Aslanis et al patent relates to complex amplitudes of the synchronizing sequence, that is, to normal complex numbers including real parts and imaginary parts which are different from each other. The reference symbol according to the invention can be recognized even in the case of large frequency offsets. Contrary thereto, the sequence according to the Aslanis et al patent does not provide for a useful correlation in the case of large frequency offsets.

The Office Action states that column 2, lines 20-25 of the Seki et al '224 patent teach amplitude modulation as recited in claims 49, 52, 72, 75, and the definition of useful symbols in each frame as recited in claims 54 and 77. This is incorrect. The text in the Seki '224 patent relied on to reject these claims merely refers to correcting reference symbols according to detected variations in amplitude and phase of the *received signal* and therefore has no relevance to the generation of the reference symbol on the transmission side as recited in these claims.

Accordingly, withdrawal of the rejection of claims 47-54 and 70-77 under 35 U.S.C. §103(a) in view of the Seki et al '389 patent in combination with the Seki et al '224 patent and the Aslanis et al patent is believed to be proper and is respectfully requested.

With regard to the rejection of claims 55-60 and 78-83 under 35 U.S.C. §103(a) in view of the Seki et al '389 patent in further view of the Aslanis et al patent, the independent claims 55 and 78 each recite a frame synchronization of a signal whose frame structure comprises a reference symbol having a real part and an imaginary part, the real part and the imaginary part being equal and formed by an amplitude modulated bit sequence. As stated above, the Seki et al patent does not

disclose or suggest frame synchronization, a reference symbol formed by an amplitude modulated bit sequence, nor insertion of such a reference symbol in time domain. Further, the Seki et al '389 patent teaches away from the present invention for reasons stated above. The Aslanis et al patent does not overcome these deficiencies and does not singly disclose or suggest a reference symbol generated using an amplitude modulated bit sequence. Finally, neither of these two references singly, nor in combination, teaches or suggests a reference symbol having a real part and an imaginary part, the real part and the imaginary part being equal and formed by an amplitude modulated bit sequence, for reasons stated above. Withdrawal of the rejection of claims 55-60 and 78-83 under 35 U.S.C. §103(a) in view of the Seki et al '389 patent in combination with the Aslanis et al patent is believed to be proper and is respectfully requested.

With regard to the rejection of claims 61-69 and 84-92 under 35 U.S.C. §103(a) in view of the Ishikawa et al patent, the Seki et al '389 patent, and the Aslanis et al patent, the independent claims 61 and 84 each recite a frame synchronization of a signal whose frame structure comprises a reference symbol having a real part and an imaginary part, the real part and the imaginary part being equal and formed by an amplitude modulated bit sequence. The Office Action refers to Fig. 3 of the Ishikawa et al patent to purportedly teach frame synchronization as recited in claims 61 and 84, except for correlating an envelope with a predetermined reference pattern in order to detect the signal reference pattern of a reference signal in a multi-carrier modulated signal. Reference is made, however, to columns 3 and 4 of the Ishikawa et al patent which state that this system is unsatisfactory for use in poor receiving conditions. The Office Action relies on the Seki et al '389 patent to purportedly overcome the deficiencies of the Ishikawa et al patent. The amplitude detector and the correlator in the Seki et al '389 patent, however, are provided downstream of the fast Fourier transform circuit 304; therefore, the amplitude detection and the correlation are conducted in the frequency domain. In addition, the reference symbols described in the Seki et al '389 patent are used for detecting a carrier frequency offset and not for

frame synchronization. Accordingly, no motivation exists to combine the Seki et al '389 patent and the Ishikawa et al patent. The Aslanis et al patent does not overcome these deficiencies and does not singly disclose or suggest a reference symbol generated using an amplitude modulated bit sequence. Finally, none of these three references singly, nor in combination, teaches or suggests a reference symbol having a real part and an imaginary part, the real part and the imaginary part being equal and formed by an amplitude modulated bit sequence, for reasons stated above. Withdrawal of the rejection of claims 61-69 and 84-92 under 35 U.S.C. §103(a) is believed to be proper and is respectfully requested.

In view of the above, it is believed that the application is in condition for allowance and notice to this effect is respectfully requested. Should the Examiner have any questions, the Examiner is invited to contact the undersigned at the telephone number indicated below.

Respectfully submitted,

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